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Technical Memorandum

Prepared for: City of Sunnyvale, CA

Project Title: Water Pollution Control Plant Strategic Infrastructure Plan

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Technical Memorandum

Subject: Plant Rehabilitation Alternative Summary

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1. EXECUTIVE SUMMARY

In the Plant Rehabilitation Alternative existing facilities are retained and rehabilitated wherever possible. The oxidation ponds are retained as the secondary treatment technology and recommendations from the Unit Process Improvements Studies Technical Memoranda are incorporated. The nitrifying fixed growth reactors, air flotation tanks and dual media filters remain as the tertiary treatment technology. New construction is recommended where existing structures have moved beyond their useful life and either the rehabilitation costs are more costly than replacement or a superior technology has emerged. All process areas will receive some level of upgrades and there are recommended changes in the process configuration but there are no major changes in the liquid stream process technology. Figures depicting the final layout of the Plant Rehabilitation Alternative and the demolition and construction staging required for execution of this alternative are included in Attachment B.

The total capital cost for this alternative is $204 million. The total yearly operational cost is $4.1 million.

2. INTRODUCTION

2.1 Background

Needed improvements at the City of Sunnyvale Water Pollution Control Plant (WPCP) are being evaluated with a Strategic Infrastructure Plan (SIP). The SIP will evaluate overall strategic alternatives for renewal of aged facilities and will recommend a specific plan for executing the selected alternative for facilities renewal. The overarching approach of the SIP is to compare the broad alternative of renovating and optimizing the existing plant facilities against the broad alternative of generally replacing the existing facility with new treatment processes. This Technical Memorandum (TM) is a comprehensive description and evaluation of the broad alternative of renovating and optimizing the existing plant facilities. This alterative is referred to as the Plant Rehabilitation Alternative.

Several preceding efforts have contributed to setting the foundation for definition and evaluation of detailed alternatives descriptions that can be used to represent and differentiate between the two strategic approaches being evaluated in the SIP:

- Decision Making Framework – A TM titled Business Case Evaluation (BCE) Based Decision Making Methodology describes a structured framework for decision making to guide an "Expert Panel" of City staff, managers, and consultants to develop appropriate decision criteria, to develop decision alternatives that address the criteria, and to select which alternative best meets the criteria. The framework and process are developed to create an alternative selection that can be rationally justified to "customers" with interests in the consequences of executing the alternative. A related TM titled Levels of Service (LOS) Measures presents the results of several Expert Panel workshops that were conducted to define the structured decision making criteria. LOS are a collection of measures intended to align the decisions related to capital projects with the values and expectations of the "customers" the project intends to serve. "Customers" can include the rate-payers, the regulators, any project partners, and the community-at-large. The LOS were organized under, first, regulatory and then three broad non-regulatory interest categories that comprise "Triple Bottom Line" analysis; "Financial", "Environmental", and "Social". Development of alternatives descriptions are based on LOS guidance.

- LOS References – Several TMs were developed to provide reference and background information for development of the LOS and as foundation information for the development of strategic alternatives. These included the following:
  - Influent Flows and Loads – An establishment of current and projected plant flow rates and pollutant loading rates that are fundamental to the physical sizing of key unit processes for wastewater treatment.
  - Solids Flows and Loads – An establishment of current and projected residual biosolids production rates that are fundamental to sizing of solids thickening processes, solids stabilization processes, solids dewatering processes, and off-site biosolids reuse / recycling programs.
  - Regulatory Framework – A summary review of the overriding and detailed laws, agencies, and regulations that establish the ultimate legal treatment performance requirements of the WPCP. Background information is also provided contributing to insights on potential future changes in regulatory requirements that may influence decision making in major treatment process modifications or improvements.
  - Seismic Performance Goals – A presentation and establishment of post earthquake performance goals for the WPCP.
  - Electrical Power System Level of Service – A discussion of reliability goals for provision of electric power for wastewater treatment processes at the WPCP. Goals for redundant power circuit designs and for reliable emergency on-site power generation are established. The role of continuous on-site power generation from biofuels is also discussed.
- Condition Assessment and Unit Process Performance Review – Prior condition evaluation assessments by other consultants formed the basis of condition assessment for the SIP and the salient conclusions of those assessments are summarized by treatment process area. Also included in this TM are conclusions about existing unit process performance drawn from both data review and interviews of plant staff with respect to specific performance and operational issues and their interests in process improvements. This review forms the much of the basis for a list of recommended improvement projects for the existing treatment processes. Further basis for improvement project recommendations was drawn from Unit Process Improvement TMs.
- Unit Process Improvement Studies – Five TMs were prepared to address specific unit processes where evaluations for significant process optimizations or improvements were of interest. These included the following:
  - Evaluation of Dewatering Alternatives – Recognizing the current gravity drainage bed method of dewatering digested sludge as overly consumptive of valuable plant site area and operationally inefficient, this TM evaluated alternative technological approaches for replacing the beds with a mechanical dewatering system that would consume much less site area and could dewater biosolids with less manual operational labor requirements. Screw presses and centrifuges were deemed favorable over belt filter press systems, with centrifuges recognized as more favorable in the event of increasing costs for off-site sludge reuse and if there is a desire to avoid 24 x 7 operation of the dewatering equipment (i.e. day shift only operation).
  - Upgrade Alternatives for Air Flotation Tanks (AFTs) – Recognizing that liquids / solids separation of algae from oxidation pond effluent with AFTs is one of the most energy, chemical, and labor intensive processes at the WPCP, this TM evaluated alternative methods of addressing liquids / solids separation and for optimizing thickening of the residual algal float product. Review of current technologies that might replace AFT (sedimentation, ballasted sedimentation, and membranes) resulted in a conclusion that AFT remains the most efficient separation and thickening process for the oxidation pond effluent. Replacement of the existing AFTs with a more modern, high efficiency AFT process was

recommended in order to reduce site area required for the unit process and to achieve a more consistently thickened algal float product, suitable for stabilization and bioenergy extraction in the anaerobic digestion process.

- Nitrification Process Improvements – Recognizing that a draft discharge permit renewal was proposing winter season ammonia nitrogen discharge limits that the WPCP had historically been unable to achieve, this TM evaluated the potential for optimizing the existing process configuration to achieve the limits and contrasted those optimizations with a proposed hybrid oxidation pond / conventional activated sludge process that would be expected to reliably meet the more stringent requirements while retaining some benefits of the oxidation ponds as a secondary treatment process. Process modeling, performance evaluation, and comparison to other nitrifying fixed growth reactors performance levels indicated a significant potential, with some recommended process modifications (that need to be tested for confirmation), that the proposed more stringent winter performance requirements could be achieved. Comparatively, the hybrid process alternative involved capital investments and strategic changes that rivaled the overall strategic alternative of complete plant process renewal. Accordingly, an immediate testing program to demonstrate the performance of optimization improvements was recommended and it was determined that the strategic alternative of renewing the existing treatment plant processes would be based on the assumed success of the recommended optimization improvements. Subsequently, the ultimate permit renewal included less stringent winter ammonia nitrogen discharge requirements, but the concern about future tightening of requirements for this contaminant remains.
- Anaerobic Digestion of Algae – Recognizing that the current practice of returning algal float from AFTs to the oxidation ponds (without harvesting) resulted in a lost opportunity for additional bioenergy production and was likely detrimental to the long term sustainability of oxidation ponds, this TM assessed the viability of instituting a continuous program of routing algal float to the existing anaerobic digestion process and post digestion solids handling facilities. The initial change of routing algal float to anaerobic digestion creates significantly more operational costs for treatment and reuse of additional digested biosolids then is returned by the offsetting value from additional digester gas production. However the analysis was broadened to compare only alternatives that ultimately harvested all biosolids production from the plant on a perpetual basis, unlike the current practice of allowing accumulation of returned biosolids in the ponds. In the broader analysis, the most economically favorable practice was determined to be digesting both primary sludge and algal float in the anaerobic digesters and then discharging the digested biosolids to the ponds (or, ultimately, to dedicated extended sludge stabilization ponds) for additional stabilization, along with a permanent dredge harvesting program to continuously remove dredged biosolids for dewatering and off-site reuse.
- Recycled Water Treatment Alternatives – Recognizing that the current practice of producing recycled water for City use by regularly and frequently reconfiguring the entire tertiary treatment process to meet the differing requirements for Bay discharge and for recycled water production was operationally inefficient and tended to create performance risks for both modes of discharge, this TM assessed alternative technology approaches for providing a recycled water production process scheme that could operate in parallel with and generally independent from the process treating most of the effluent for Bay discharge. For the overall strategic alternative of renewing the existing treatment processes, the recommended parallel treatment system includes separate and dedicated process units for dissolved air flotation, dual media filtration, and hypochlorite disinfection of oxidation pond effluent in order to meet the stricter quality requirements for recycled water production. For the overall strategic alternative of replacing the existing treatment plant processes, an alternative configuration was recommended that includes cloth media filters and UV disinfection of conventional activated sludge treatment process effluent.

- Early Execution Projects – This TM made an evaluation of very critical, higher risk improvement needs that could be candidate projects to execute in advance of final completion of the SIP. Process facilities meeting the following criteria were candidates for early execution:
    - Process facilities known to be significantly deteriorated and at higher risk of unanticipated failures.
    - Processes that would be included in either of the major plant rehabilitation scenarios.
    - Processes that could be located in the same location, regardless of which major plant rehabilitation scenario is selected in the SIP.

  The processes that were recommended for early execution, along with a proposed layout, were:
    - Raw sewage screening and screenings processing
    - Raw sewage pumping
    - Grit removal and grit processing
    - Primary sedimentation and primary sludge pumping
    - Primary effluent pipeline
    - Main plant electric switchgear center and diesel standby power facility
    - Primary sludge thickening

2.2 Purpose and Objectives of TM

The purpose of this TM is to describe the entire alternative plan associated with the scenario that rehabilitates the existing plant processes. The following objectives are addressed:

- Describe what facilities are planned to be replaced and / or rehabilitated.
- Describe the schematic arrangement of the processes
- Describe design and sizing criteria for the processes
- Describe the proposed layout on the plant site for the processes
- Describe the sequence of construction and recommended construction packages.
- Present the estimate of probable construction cost.
- Estimate the major operational costs for the processes.
- Describe the sustainability related characteristics of the alternative.

3. DESCRIPTION OF PLANT REHABILITATION ALTERNATIVE

3.1 Defining Characteristics of Plant Rehabilitation Alternative

In the Plant Rehabilitation Alternative existing facilities are retained and rehabilitated wherever possible. The oxidation ponds are retained as the secondary treatment technology and recommendations from the Unit Process Improvements Studies TMs are incorporated. The nitrifying fixed growth reactors, air flotation tanks and dual media filters remain as the tertiary treatment technology. New construction is recommended where existing structures have moved beyond their useful life and either the rehabilitation costs are more costly than replacement or a superior technology has emerged. All process areas will receive some level of upgrades and there are recommended changes in the process configuration but there are no major changes in the liquid stream process technology.

The new construction in this alternative is driven by the Unit Process Improvements Studies TMs and the Early Execution Projects TM described in more detail in the previous section. The following describes the new construction in the Plant Rehabilitation Alternative

- The Headworks and Primary treatment facilities were deemed a critical and high risk improvement to happen as an early execution project. New construction for these facilities is driven by cost and timing of the projects. It is essential that this construction not restrict future SIP alternatives.
- While AFTs were determined to be the best liquids/solids separation technology for oxidation pond effluent, the extent of rehabilitation necessary to the existing tanks and the progress made in AFT treatment technology design make construction of a new AFT process the ultimate recommendation for this alternative.
- Construction of a new centrifuge dewatering facility is driven primarily by space concerns, however, extensive labor requirements and operational inefficiencies associated with the existing system also play a large role.

There are changes to the current mode of operation that are recommended by the Unit Process Improvements Studies TMs. These improvements seek to help the WPCP meet future regulations and optimize the treatment process.

- The work in the Nitrifying Process Improvements TM shows that by operating with the Nitrifying Trickling Fixed Growth Reactors (FGRs) after the AFTs and making other process modifications the WPCP could potentially meet the proposed ammonia nitrogen discharge limits. This is a departure from the current WPCP operation whereby the AFTs follow the FGRs in the process treatment train.
- The recommendation of a full scale algae digestion program is a departure from historical operation but would increase the bioenergy production at the WPCP and free capacity in the oxidation ponds. The move to algae digestion also include a significant and permanent dredge harvesting program.

This alternative also includes new construction of a recycled water treatment system that could treat up to 4 million gallons per day. This new construction is driven by a desire to escape the operational difficulties associated with the current mode of operation for producing recycled water.

3.2 Treatment Process Schematic Descriptions

The liquid stream schematic for this alternative is show in Figure 3-1.

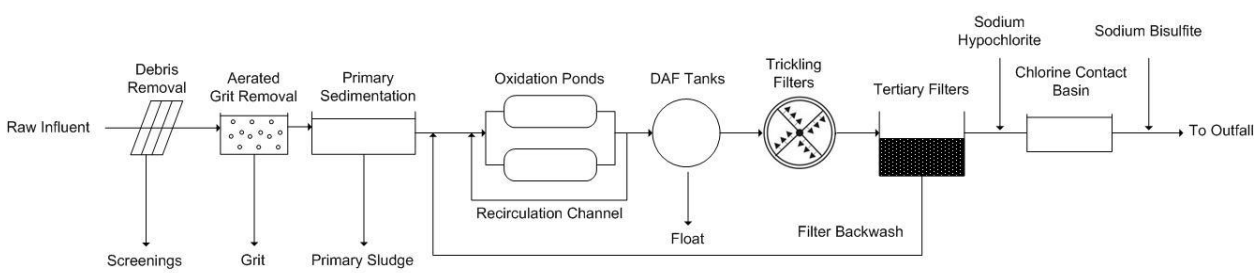


Figure 3-1. Liquid-phase treatment process schematic for plant replacement alternative

As shown in Figure 3-1, the major process change is the location of the FGRs (shown as Trickling Filters) in the process train. The newly constructed facilities are not a drastic change to the process technology used currently. Screenings and grit are hauled off-site. All other solids are processed through the solids handling system. A schematic for the solids process train is shown in Figure 3-2.

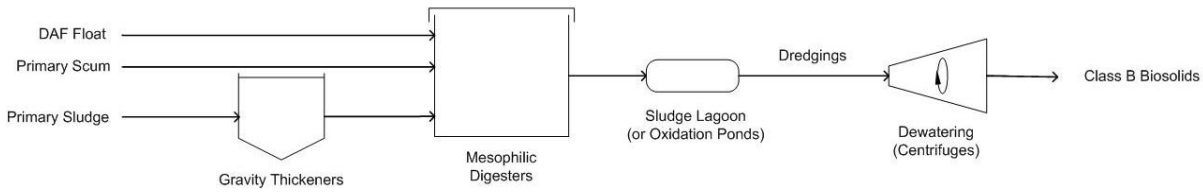


Figure 3-2. Solids stream process schematic for plant replacement alternative

The solids treatment stream is modified by the addition of the algae in DAF float for digestion. Anaerobic digestion at mesophilic temperatures remains the digestion technology but further stabilization is achieved with a new sludge lagoon.

Specific descriptions of each process area are provided in Section 3.3.

3.3 Unit Process Descriptions

This section provides an overview of the key processes associated with the Plant Rehabilitation Alternative. Details on equipments and other assets within each process area, as well as, unit process sizing and design criteria can be found in the asset summary table in Attachment A.

3.3.1 Headworks

Preliminary treatment will consist of the following processes (listed in order of upstream to downstream):

- Debris removal: Currently, the Sunnyvale WPCP has grinders which grind influent debris, but do not actually remove it from the liquid stream, therefore nuisance materials are conveyed downstream. The new debris removal system will consist of mechanically cleaned deep screens located in deep channels which will remove large debris completely from the process and convey it to a washer and compactor system. This washer and compactor washes away organic matter, reduces odors, and prepares the screenings to be hauled away (processed screenings are stored in a bin for 2-3 days).
- New raw sewage pumping station: A trench-style, self-cleaning wet well collects the screened wastewater and lifts it to the pre-aeration grit removal tanks. The pumping station consists of variable speed vertical turbine solids handling pumps that have the capacity to handle peak hour influent flows projected for 2035. Footprint for additional pump bays will be provided for potential expansion to include the projected ultimate influent flow.
- Grit removal: The existing grit removal tanks are outdated and not optimally configured for grit separation. New aerated grit basins will be constructed to promote separation and collection of grit material, and a vortex grit washer and dewatering vessel will process the grit for disposal. Aerated grit basins are preferred over vortex grit basins because they are better suited for peak flow conditions.

The new headworks will be connected to the existing collection system via a junction structure that connects the two existing 48-in diameter influent sewers with one new 54-in diameter sewer. The new influent sewer is reinforced concrete pipe and runs for approximately 200 linear feet (LF) to the new headworks.

3.3.2 Primary Sedimentation

New primary sedimentation tanks will be constructed in the eastern portion of the plant and will not be directly connected to the grit removal tanks, as is currently the case. Prior to construction of the new process, the City will need to demolish the existing sludge dewatering beds and sludge pumping station. The new process will consist of 5 rectangular sedimentation tanks which are designed to settle out particulate material and produce a primary effluent that contains mainly dissolved organic matter. Within each tank, overflow launders and chain-and-flight sludge collectors accommodate liquid-solids separation and transport of settled

primary sludge. Primary sludge will not be thickened in the primaries, but instead sludge will be pumped to a separate process for thickening with circular gravity thickening units.

A new 60-in diameter primary effluent pipeline will be constructed and connected to the new primary effluent channel. This pipeline will convey effluent to the pond system for secondary treatment and will replace the existing primary effluent pipeline.

This alternative assumes that no chemicals will be used in the process to increase total suspended solids (TSS) and biochemical oxygen demand (BOD) removal, a system typically referred to as chemically enhanced primary treatment (CEPT). Because of this, the only energy requirement in the process is for the sludge scraper mechanisms and sludge pumping, which results in relatively low energy costs.

3.3.3 Oxidation Ponds

The oxidation ponds are retained as the secondary treatment technology in the Plant Rehabilitation Alternative. The rehabilitation and improvements to the ponds include:

- Replacing the corrugated metal pipes that transfer flow between the ponds and the recirculation channel. These pipes are corroded and the potential for collapse of pipes under levees could compromise containment of the ponds.
- Reconstruction of the levees surrounding the ponds. The existing levees are overgrown and have settled and eroded in areas. This work will be a continuation of improvements work started in 2003.
- Replacement of the existing pond effluent pump station and structure.
- Replacement of the pond effluent pipeline for return of effluent to the tertiary treatment process.
- Upgrades to and equipment replacement in the recirculation channel pump station. A mechanically cleaned bar screen will ease effort on maintenance functions and new pumping equipment will improve operation.
- Replacement of in-channel mechanical aerators in the recirculation channel.
- Construction of a sludge lagoon for further stabilization of anaerobically digested biosolids. This lagoon will be continuously dredged.
- Implementation of a full scale dredging system to remove settled biosolids from the ponds. This project will start as a pond capacity restoration project but will continue as a permanent operation in conjunction with the newly constructed sludge lagoon.

3.3.4 Dissolved Air Flotation Clarification

Based on the recommendations from the Upgrade Alternatives for AFTs TM the existing circular AFTs will be replaced with new rectangular AFTs (commonly referred to as Dissolved Air Floatation Tanks or DAFTs). The new construction will include all tanks, associated equipment, polymer feed system and a float conveyance pipe to transfer float to the digesters.

This new system is an improved technology that will allow for a significantly smaller footprint as compared to the existing system and will produce a thicker DAF float better suited for anaerobic digestion. Four tanks will be required but the size of each tank is significantly smaller than the current tanks. The DAFTs will be built within the same footprint as the existing tanks.

3.3.5 Nitrifying Trickling Filters

The Nitrifying Tricking Filters (more commonly used term for the FGRs) will continue to be the nitrifying process technology in this alternative. The NTFs were built with the 1973 Tertiary Facilities project and have aged associated equipment and structures. The upgrades and modifications to the NFTs are described here.

- New influent pump station – The new structure will replace aged equipment and provide additional redundancy and operational flexibility.
- Snail control system – Snails are a predator organism that can effect ammonia removal as well as downstream processes. The control system will use an operational mode with chemical treatment to control snail populations.
- Tank modifications – These upgrades include replacement of the top 4 feet of media, replacement of the mechanical distributors, re-installation of ventilation fans and concrete rehabilitation of the tanks.
- New digester/dewater return pump station - Fixed growth reactors respond slowly to increasing ammonia concentrations. Directing internal ammonia laden return flows to fixed growth reactors will keep them more ready to accommodate increasing seasonal concentrations from pond effluent.

3.3.6 Dual Media Filtration

Dual media filters are currently used by the City to reduce the turbidity in the effluent prior to disinfection. For the Plant Rehabilitation Alternative, the filters would remain, but would be modified with the following upgrades to aid performance:

- Both of the layers of media would be replaced.
- The existing controls would be replaced with PLC based controls.
- New backwash pumps and air blowers would be installed; existing equipment is nearing the end of their useful life.
- New valving and piping will be installed.

The footprint of the filter area will not change in this alternative.

3.3.7 Disinfection

Disinfection is currently provided using chlorine gas through two chlorine contact basins which have sufficient contact time to meet disinfection requirements. As part of adhering to City level of service requirements, the master plan calls for abandoning the practice of using the hazardous gas at the WPCP, with disinfection in the future provided by addition of sodium hypochlorite or treatment by UV light. In the Plant Rehabilitation Alternative, disinfection will be achieved using a sodium hypochlorite system.

Sodium hypochlorite, a liquid solution at atmospheric conditions, will be delivered by truck and stored in tanks on the west side of the plant site. A dose appropriate for disinfection will be metered into the dual media filter effluent, upstream of the chlorine contact chamber. Dechlorination of the disinfection system effluent would still be necessary before discharge, though the existing sodium dioxide system will be replaced with a sodium bisulfite system (currently being designed).

In addition to the modification of disinfectant used, the following improvements will be made to the existing disinfection process:

- Increase chemical mixing and distribution efficiency by modifying the flow distribution channel to include a rapid mixer.
- Replace the effluent flow meter.
- Rehabilitate the concrete tanks by replacing aged concrete.

- Construct a new sodium hypochlorite storage area, spill containment structure, and feed pump station

The capacity of the chlorine contact chamber will not be modified and the upgraded process will occupy essentially the same footprint as the existing process.

3.3.8 Primary Sludge Thickening

Existing plant operations thicken primary sludge within the primary sedimentation tanks. This leads to widely varying solids removal efficiencies from primary sedimentation process and consequently, a significant portion of otherwise settleable solid organic matter is passed on to the downstream processes. Separate thickeners allow constant pumping of thin sludge from primary sedimentation tanks, improving the overall removal rate of settleable solids. More efficient removal in the primary sedimentation tanks promotes improved energy recovery from wastewater processes because biosolids captured in primary sedimentation tanks lead to the highest net energy yields from the organic matter in the anaerobic digestion process.

All primary sludge will be thickened in circular gravity thickener tanks. The sludge will be removed from the primary sedimentation tanks at approximately 0.5 percent solids and will be thickened to 4 percent solids. Two gravity thickener tanks will be constructed on the site of the existing sludge dewatering beds just north of the new primary clarifiers.

3.3.9 Anaerobic Digestion

Sludge solids destruction in the anaerobic digesters results in reduced biosolids hauling costs. The existing digestion system produces Class B biosolids, as defined by the US Environmental Protection Agency (USEPA). Biogas produced in the digesters contains methane, which is converted to electricity in the power generation facility. The WPCP currently uses mesophilic digestion as its stabilization process, which is defined as operation at temperatures between 30 to 38 degrees Celsius (C) and in the absence of molecular oxygen. The digester temperature determines the rate of solids destruction. The digester hydraulic retention time (HRT) determines the degree of solids destruction, with higher solids destruction occurring at higher HRT values. The WPCP mesophilic digestion process is typically operated at HRT value of 15 days or greater.

In this alternative the algae float will be sent to the digesters for anaerobic digestion. This will increase the amount of biogas produced. The existing digesters have the capacity to handle this additional load and the increases in load predicted to the end of this planning period. The improvements to the digesters involve installing modifications that will improve digester operation and efficiency. Following are the assumed improvements:

- Completion of conversion from floating covers to fixed covers for all four digesters (this upgrade is underway with one digester currently converted to the new cover type).
- Upgrade digester heating and heat recovery for all four digesters
- Conversion from the current gas mixing system to a pumped mixing system.
- Installation of an automated sludge conveyance system throughout the digestion process, resulting in continuous sludge feed, mixing, and withdrawal. This includes installation of new sludge feed pumps and recirculation pumps.

Improvements to digester gas management and cogeneration of power will also be included in the digestion upgrades. Following are the assumed improvements:

- Construction of two 45-ft diameter, 50,000-gallon capacity gas storage tanks
- Construction of a gas moisture separator, gas conditioning heat exchanger, and two digester gas chillers
- Construction of an iron sponge hydrogen sulfide (H_2S) reduction system and an activated carbon adsorption system for reduction of siloxanes

- Construction of new gas compressors, gas booster blowers, boilers, and flares

3.3.10 Dewatering and Loadout Facilities

The dewatering facility will receive dredged, stabilized biosolids from the sludge lagoon. The new facility will be located on the southern portion of the site and will have a significantly smaller footprint than the existing system. The choice of dewatering technology is based on recommendations from the Evaluation of Dewatering Alternatives TM. Both screw press and centrifuge technology were deemed appropriate for the dewatering process at Sunnyvale. The TM evaluated sensitivity to power and hauling costs. Increases in hauling costs would make centrifuges the preferred dewatering technology due to the higher quality cake produced by centrifuges. For this alternative centrifuges were selected for dewatering.

The new dewatering building will include the centrifuge units and associated equipment as well as a conveyance system and sludge hoppers for convenient loadout and off-site hauling.

3.3.11 Recycled Water

The new recycled water system will be built on a portion of the existing primary sedimentation tank and the existing AFTs. This system will treat up to 4 mgd of pond effluent with the possibility of expanding to 8 mgd. This will allow for operational flexibility and prevent treatment upsets due to switching between recycled water production mode and bay discharge mode as is necessary in the current process flow configuration.

The recycled water system will consist of two chlorine contact tanks, four rectangular AFTs and four dual media filters.

3.4 Supplemental Plant Amenities

The following sections present basic conceptual information on other areas of the rehabilitated plant that provide support to the processes described in Section 3.3.

3.4.1 Power Generation

The following electrical elements are assumed for the new plant alternative:

- The main power distribution center, which includes two main switchgears and sets of transformers that convert electricity supplied by Pacific Gas and Electric (PG&E) to 12-kilivolt (kV) power. Each switchgear includes new switching, conductors, conduits, and transformers to provide a fully redundant feed system. The electrical components of the main power distribution center are contained within the new power distribution center building.
- Stand-by power with a capacity of 2,000 kilowatts (kW) is provided by an emergency generator which is powered by diesel fuel. The stand-by power facility, including a diesel storage tank, is also located within the new power distribution center building.
- Two new area substations transfer power to the following process areas: (1) Headworks and primary clarifiers and (2) dual media filtration and recycled water. Each of these substations receive 12.47 kV from the main power distribution center, and each has a capacity of 480 volts (V).

Additionally, there will be improvements to the existing biogas power generation facility, whereby the system will be optimized to operate using biogas only. For this system, the engines will be replaced with more modern engines that include the advanced reciprocating engine systems (ARES) technology – a combined heat and power system – which would reduce operational and maintenance costs and are more likely to meet future emissions standards, in particular for nitrogen oxides. The inlet gas treatment systems will also be upgraded (see Section 3.3.9).

3.4.2 Relocated Utilities Building

Plant utilities are currently housed within the existing primary control building. This building will be demolished during the upgrades, thus the existing utilities will have to be relocated (and new utilities would be housed in the new location). One of the main systems to be located is the plant hot water looping pumping system, which is used to convey hot water throughout the plant. Equipment such as steam separators, blowers, and heat exchanger components will need to be moved into the new building. In cases where the equipment is nearing the end of its useful life, the equipment would need to be replaced.

3.4.3 New Maintenance Building

The existing maintenance shed is adjacent to the existing primary control building, which will be demolished in the rehabilitation alternative. A new maintenance building will be constructed to serve all maintenance and garage functions.

3.4.4 Landfill Gas Booster and Flare System

Because of necessary demolition and new construction in the southern part of the plant, the existing landfill gas booster and flare system needs to be moved to the northern portion of the main plant. In cases where the equipment is nearing the end of its useful life, the equipment would need to be replaced.

3.4.5 Community and Environmental Enhancements

The following community and environmental enhancements are assumed for this alternative:

- Construction of a new access road for site service.
- Construction of kiosks at the entrance to the oxidation ponds.
- Construction of new openings for trail parking access

3.4.6 New Administration Building

In this alternative, the existing administration building will be demolished and a new building will be constructed that is larger than the existing building. A concrete masonry unit (cmu) building is assumed, with the building including laboratory facilities and occupying a larger footprint than the existing building.

3.5 Treatment Process Layout Descriptions

The final layout for the Plant Rehabilitation Alternative is shown in Figure B-1, located in Attachment B. All new construction is shown and areas that will receive upgrades are also indicated on the figure. The layout includes space allocation for future construction should the ultimate flow allocation be reached at the WPCP.

3.6 Project Sequencing Descriptions

The plant upgrades and new construction will occur on a site that is currently operational and must remain so during rehabilitation activities. To accomplish this, careful thought was given to appropriate construction sequencing. The construction and demolition sequencing is shown in Figures B-2 – B-4 in Attachment B. Stage numbers on each drawing indicate the sequencing within each figure.

- Figure B-2 includes the demolition and construction activities associated with the early execution projects (headworks, raw sewage pumping station, primary clarifiers, etc). Demolition of the sludge dewatering beds is necessary prior to construction. After the new facilities are operational the existing facilities can be demolished to make room for other improvements included in the alternative.

- Figure B-3 includes upgrades, demolition and new construction related to the tertiary system and the digesters. There are four stages labeled on this figure.
- Figure B-4 includes construction and minimal demolition primarily related to the recycled water system but also includes new DAFTs, solids dewatering and the maintenance building. There are only two stages shown in this figure.

4. EVALUATION OF PLANT REHABILITATION ALTERNATIVES

4.1 Cost Evaluation Summary

This section includes a summary of capital and operational costs for the Plant Rehabilitation Alternative. The cost estimates are assumed to be planning level.

4.1.1 Capital Cost Summary

Estimates of capital costs for the Plant Rehabilitation Alternative are summarized in Table 4-1. The capital cost estimate was prepared using preliminary design calculations, vendor quotes, and equipment pricing furnished by the design team or by the estimator. The estimate includes direct labor costs, anticipated productivity adjustments to labor, and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors were used. Assumptions about construction time periods were used to appropriately assign escalation factors.

Table 4-1. Plant Rehabilitation Capital Cost Summary (in Millions of Dollars)

Process/Improvement Area	Sub-Process	Capital Cost
Headworks	Influent Screening	3.7
	Raw Sewage Pumping	5.9
	Grit Removal	4.3
Primary Sedimentation	Primary Sedimentation Tanks	15.4
	Primary Effluent Pipeline	2.6
	Primary Sludge Thickening	1.9
Oxidation Ponds	Sludge Lagoon	15.7
	Pond Restoration	7.0
	Pond Effluent Pump Station	3.4
	Recirculation Channel	3.4
Nitrifying Trickling Filters	NTF Upgrades	8.3
Air Floatation Separation	Rectangular DAFTs	12.5
Dual Media Filters	Filter Upgrades	3.3
Disinfection	Contact Channel Upgrades	0.9
	Disinfection Management	2.7

Table 4-1. Plant Rehabilitation Capital Cost Summary (in Millions of Dollars)		
Process/Improvement Area	Sub-Process	Capital Cost
Recycled Water	Dual Media Filters + Hypochlorite	15.0
Anaerobic Digestion	Anaerobic Digestion Upgrades	17.3
	Digester Gas Management	8.3
Dewatering	Centrifuges	24.3
Relocated Facilities	Utilities Building	1.5
	Landfill Gas Booster and Flare System	0.8
	Maintenance Facility	1.1
	New Administration Building	3.1
Electrical Power	Main Power Distribution Center (with Stand-By Power)	2.7
	Area Substations	7.1
	Biogas Power Generation	10.3
Demolition	Demolition of Existing Facilities	16.6
Civil / Site Work	Activities in Existing Plant Area	3.3
Community Improvements	Community Improvements	0.3
	Total Capital Cost Estimate	204

Based on the necessary construction sequencing and appropriate project bidding procedure three bid packages were developed for this alternative. The timeline of those bid packages is show in Figure 4-1.

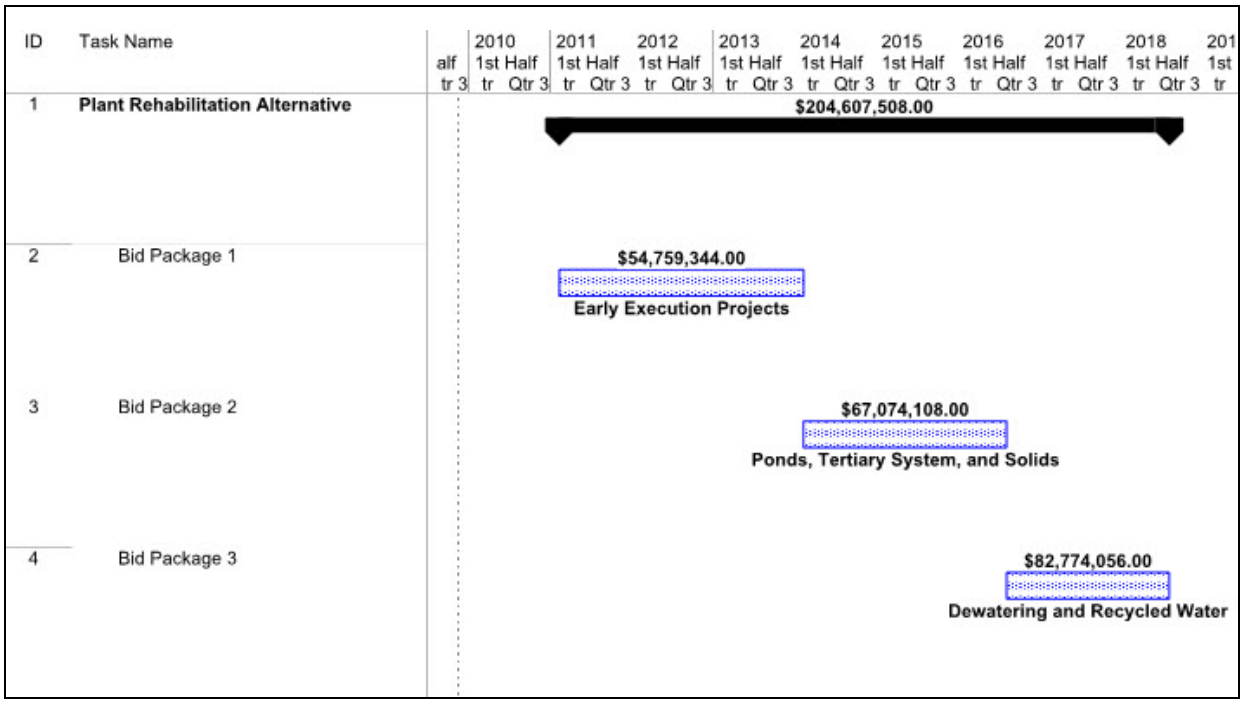


Figure 4-1 Schedule by Bid Package for Plant Rehabilitation Alternative

A summary table of costs by process area and bid package is located in Attachment C.

4.1.2 Operational Cost Summary

Estimates for annual operating costs are summarized in Table 4-2.

The following assumptions are made in the cost estimates:

- Power consumption is presented in total megawatt-hours per year (MW-hr/yr) and power costs are calculated by assuming an electricity cost of $0.20/kW-hr.
- Cost of sodium hypochlorite is $0.71/lb chlorine
- Cost of sodium bisulfite is $803/ton
- Cost of ammonium sulfate is $215/ton
- Cost of caustic soda is $380/ton
- Cost of polymer for dewatering is $1.25/active lb and for DAFT thickening is $5.30/active
- Biosolids hauling cost is $44.69/wet ton
- Sand media replacement cost is $20/ft^3
- Anthracite media replacement cost is $30/ft^3

Table 4-2. Plant Rehabilitation Operating Cost Summary		
Consumable Item	Quantity	Cost (dollars)
Power Consumption (kW-hr/yr)	7,715,000	1,543,000
Ammonium Sulfate (gal/yr)	5,000	7,900
Sodium Hypochlorite (gal/yr)	44,000	400,000
Sodium Bisulfite (gal/yr)	40,000	180,000
Caustic Soda (gal/yr)	2,000	4,900
DAFT Polymer (gal/yr)	103,000	1,560,000
Dewatering Polymer (gal/yr)	6370	27,000
Biosolids Hauling (wet ton/yr)	8,600	388,000
Sand Media Replacement (ft^3)	2,300	9,300
Anthracite Media Replacement (ft^3)	5,600	34,000
	Total Operational Cost Estimate	4,154,000

Note: Sand and Anthracite Media will be replaced every 10 years. The quantity value represents the amount to be replaced every 10 years but the cost is annualized.

These costs include items that will have a significant cost impact such as the power draw of large motors or chemical consumption for disinfection. Mechanical devices with smaller demand such as clarifier mechanism rotating drives and bar screen cleaning mechanism drives were not included. This cost is not meant to be to a comprehensive operations and maintenance cost but it does capture the major costs that will impact this alternative. These costs reflect operation of all units at their final constructed or upgraded state.

5. CONCLUSIONS

In the Plant Rehabilitation Alternative existing facilities are retained and rehabilitated wherever possible. The total capital cost for this alternative is $204 million. The total yearly operational cost is $4.1 million.

ATTACHMENT A: ASSET SUMMARY TABLE

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Headworks / Raw Sewage Pumping — *Lifts raw wastewater to grit removal facilities*

Improvement	*Description*
Influent Flow Measurement	**New open channel flow meter down stream of influent pumping station**

	Type	Description	Notes
Influent Flow Meter	Open channel flow meter	100 mgd capacity	

Influent Pump Station — **Self cleaning, trench-style wet well**

	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Pump Station Structure	1	25 ft	87 ft	30 ft		Concrete	Footprint based on 5 pumps, 2 future. Below ground structure, no building

Influent Sewer — **New influent sewer to convey raw wastewater to screening facilities**

	Length	Diameter	Material	Notes
Influent Sewer	190 ft	4 ft	Reinforced Concrete Pipe	22 ft invert depth below grade, 0.001 slope
Junction Structures		48-in and 54-in pipelines	Concrete	Needed for connection to existing influent sewers

Raw Sewage Pumps — **Vertical turbine solids handling influent pumps**

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Pump 5	VTSH	1	50	5000	gpm	Install smaller pump for lower flows Pump efficiency = 80%
Pumps 1 - 4	VTSH	4	100	10000	gpm	Includes VFD electric motors Pump efficiency = 80%

Headworks / Screening — *Removes large debris from influent raw wastewater*

Improvement	*Description*
Screenings Storage	**Structure to support short-term storage and load out of washed screenings debris**

	No of stories	Length	Width	Height	Construction Material	Notes
Concrete Pad	0	12 ft	12 ft	1 ft	Concrete	For structural support of screenings bin
Canopy		12 ft	12 ft	10 ft	Fabric	Canopy to cover storage bin for rain protection

	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Storage Bin	1	6 ft	3.5 ft	4.2 ft		Metal	3.2 cu yd of storage Assume bins on site for 3 days

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Headworks / Screening — *Removes large debris from influent raw wastewater*

Improvement	*Description*
Screenings Washer / Compactor	**Equipment that collects removed screenings, washes away organic matter, and dewaters the cleaned debris**

	Type	Description	Notes
Washer/Compactor	Screenings washer/compactor	4 cu ft/hr capacity	2 units (1 duty/1 stand-by) Assume 1.4 cubic ft screenings per million gallons wastewater influent

Screens — **Deep channels and mechanically cleaned screening equipment**

	Type	Description	Notes
Influent Screens	Mechanical Screen	3/8 inch openings	3 screens at 17 mgd capacity for each screen 3/8 inch openings Design criteria: 0.9-1 mgd/sq ft screen

	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Influent channels	3	30 ft	6 ft	22 ft		Concrete	Deep channels for influent screening Design criteria: channel velocity = 3 ft/s

Headworks / Grit Removal — *Facilities to remove inert, abrasive, sand-like particles from incomiong sewage*

Improvement	*Description*
Aerated Grit Removal Tanks	**New baffled aerated tanks that are shaped to promote separation and collection of grit materials**

	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Grit tanks	2	24 ft	45 ft	17 to 30 ft		Concrete	2 tanks with 3 hoppers each Design criteria: 5 min detention time at peak hour flow

Aeration Equipment — **Piping and diffusers to supply coarse bubble air to aerated grit tanks**

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Aerated Grit Blowers	Multi-stage Centrifugal	3	50	750	scfm	10 psig, blowers to be located in gallery structure Design criteria: 12.4 scfm per ft tank length

Gallery structure — **New below grade structure to house grit removal pumps**

	No of stories	Length	Width	Height	Construction Material	Notes
Gallery	1	100 ft	28 ft	20 ft	Concrete	Adjacent to grit removal tanks and below grade

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Headworks / Grit Removal — *Facilities to remove inert, abrasive, sand-like particles from incomiong sewage*

Improvement	*Description*
Grit Removal Pumps	**Pumps that withdraw grit slurry from deep hoppers in bottom of grit removal tank**

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Grit pumps	Recessed impellar (severe duty)	3	20	125	gpm	Approx 51 ft of head 65% mechanical efficiency 95% motor efficiency

Grit Storage Bin and Loadout — **Facilities to temporarily store washed grit and accommodate loading for off-site transportation to disposal**

	No of stories	Length	Width	Height	Construction Material	Notes
Canopy	1	13 ft	12 ft	10 ft	Fabric	
Concrete Pad	1	12 ft	13 ft	1 ft	Concrete	Foundation for grit storage bin (structural support)

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Storage Bin	1	6 ft	5.3 ft	4.7 ft		Metal	Cover to prevent rain entry 5.5 cu yd storage Assumes bins on site for 3 days

Vortex Chamber Grit Washers — **Equipment to accept, wash, and dewater grit slurry that is pumped from aerated grit basins**

	Type	Description	Notes
Grit Washers	Huber Coanda Grit Washer RoSF4	2 units	8 ft diameter vortex chamber 375 gpm capacity each 1 duty / 1 stand-by Assume 2.6 cubic ft grit collected per million gallons wastewater influent

Primary Sedimentation / Primary Sedimentation Tanks — *Tanks that separate settled solids from incoming sewage*

Improvement	*Description*
Gallery Structure	**Below grade structure adjacent to all primary sedimentation tanks to house pumping equipment for primary sludge, primary scum, and thickened primary sludge**

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Gallery Structure	1	105 ft	100 ft	20 ft		Concrete	New below-grade gallery structure to house pumping eqipment

New Inlet Distribution Channel — **Channel that distributes incoming sewage between multiple tanks and keeps organic solids in suspension**

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Primary Sedimentation / Primary Sedimentation Tanks ***Tanks that separate settled solids from incoming sewage***

Improvement	*Description*						
	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Inlet channel	1	100 ft	10 ft	10 ft		Concrete	
New Primary Effluent Collection Channel	**Downstream channel structure to aggregate primary effluent flows from multiple operating tanks**						
	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Primary Effluent Channel	1	100 ft	10 ft	10 ft		Concrete	
New Primary Sedimentation Tank equipment	**Overflow launders and sludge collectors that accommodate overflow liquid solids separation and intra-tank transport of settled primary sludge**						
	Type	Description					Notes
Sludge collectors	Chain and flights	5 units					5 sets of chain and flight sludge collectors
Scum collectors	Scum collection equipment	5 units					
Sluice gates	Sluice gates	10 gates					Upstream and downstream end of each tank
New Sedimentation Tanks	**Concrete tanks**						
	Quantity	Length	tank width	Depth	Diameter	Construction Material	Notes
Primary Sedimentation Tanks	5	105 ft	20 ft	10 ft		Concrete	Design criteria: At ADWF, SOR = 2000 gpd/sq ft At Peak Day flow, SOR = 4000 gpd/sq ft
Primary Scum Pumps	**Pumping equipment for pumping primary scum from primary sedimentation tanks to anaerobic digesters**						
	Type	Quantity	Horse power	Capacity	Capacity Units		Notes
Primary Scum Pumps	Submersible screw centrifugal	8	4	150	gpm		5 duty, 3 standby
Primary Sludge Pumps	**Pumping equipment for pumping primary sludge from primary sedimentation tanks to primary sludge thickeners**						
	Type	Quantity	Horse power	Capacity	Capacity Units		Notes
Primary Sludge Pumps	Positive displacement rotary lobe	8	15	150	gpm		5 duty pumps and 3 stand-by Projected 2035 primary sludge load to digesters = 13,200 lb/day

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Primary Sedimentation / Primary Sludge Thickening

Separate process unit to further thicken primary sludge pumped from primary sedimentation tanks

Improvement	*Description*
Thickened Primary Sludge Pipeline	**Pipeline to convey thickened sludge to anaerobic digesters**

	Length	Diameter	Material	Notes
Thickened sludge pipeline	1000 ft	12 inch		745 gpm capacity

Thickened Primary Sludge Pumps — **Pumping equipment for pumping thickened primary sludge from primary sludge thickeners to anaerobic digesters**

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Gravity thickened sludge pumps	Recessed impeller variable speed pumps	4	15	100	gpm	2 duty and 2 standby

Thickener equipment — **In-tank launders to promote clarification overflow and thickened sludge collection equipment to convey thickened sludge to collection sump on floor**

	Type	Description	Notes
Gravity thickener launder	In-tank launder		Launders to promote clarification overflow
Gravity thickener sludge collector	Sludge collector		Used to convey thickened sludge to collection sump on floor

Thickener tanks — **Concrete circular tanks sized for clarification of underflow from primary sedimentation tanks**

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Gravity thickening tanks	2			12 ft	35 ft	Concrete	Overflow rate is 7.5 kg TSS/m2-hr

Primary Sedimentation / Primary Effluent Pipeline

Pipeline from new primary effluent channel to oxidation ponds

Improvement	*Description*
New Primary Effluent Pipeline	**Pipe to transport primary effluent from primary sedimentation area to recirculation channel in oxidation ponds system**

	Length	Diameter	Material	Notes
Primary Effluent Pipeline	1000 ft	60 in	RCP	Replace currently primary effluent pipeline

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Oxidation Ponds / Sludge Lagoon — ***Construction of deeper dedicated area within ponds for digested sludge stabilization***

Improvement	*Description*
Sludge Lagoon	

Oxidation Ponds / Pond Upgrades — ***Upgrades to the large, facultative treatment ponds to provide soluble BOD removal***

Improvement	*Description*
Dredging System	**Dredge and associated piping and equipment for removal of solids from the ponds**

	Type	Description				Notes
Dredge	Sludge Dredge	1000 gpm				VMI Tier 3 diesel dredge
Dredge Cable and Harness	Cable and Harness	Ancillary dredge equpiment				
Gangway and Crank	Gangway and hand crank	Used for maintenance activities				
	Length	Diameter	Material			Notes
Dredge off-shore piping	150 ft	6 inch	Flexible piping			
Dredge off-shore floating piping	6000 ft	8 inch	PVC piping on floats			
Dredgings Transport Pipeline	**Pipeline from dredgings transport pump station to dewatering facilities at treatment plant site**					
	Length	Diameter	Material			Notes
Dredging Transport Pipeline	3600 ft	8 inch	DI			Buried pipe along pond levee to treatment plant
Dredgings Transport Pump Station	**Station at ponds to receive dredged biosolids and pump them to dewatering facilities at the main treatment plant site**					
	No of stories	Length	Width	Height	Construction Material	Notes
Pump Station Structure	1	25 ft	15 ft		Concrete	Concrete pad with pumps, no cover needed
	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Dredging Booster Pumps	Screw centrifugal	2	5	500	gpm	40 ft of head, WEMCO or Hayward Gordon recommended
Replace pond transfer pipes	**Replace aged corrugated metal pipes that transfer pond contents to and from the pond recirculation channel**					

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Oxidation Ponds / Pond Upgrades

Upgrades to the large, facultative treatment ponds to provide soluble BOD removal

Improvement	*Description*					
	Length	Diameter	Material			Notes
Pond Transfer Pipes	80 ft (each)	30 inch	Corregated Metal			There are 48 pipes around the ponds. Currently some of the pipes are being repaired and replaced. This is a continuation of that project.
Upgrade levees	**Restore shoreline and vehicle access routes around ponds. Provide amenities for public use of levees as trails**					
	No of stories	Length	Width	Height	Construction Material	Notes
Levee reconstruction	0					Continuation of levee improvements started in 2003.
Levee rip rap	0					Continuation of levee improvements started in 2003.

Oxidation Ponds / Pond Effluent Pump Station

Pump staiton and pipeline to convey pond effluent back to tertiary treatment site

Improvement	*Description*					
Replace Electric Power Supply	**Replace conduits, wiring, and switching for power supply to pump station**					
	Type	Description				Notes
Pond Effluent Pumping Electrical	Conduits and MCC	Replace all equipment				
Replace Pond Effluent Pipeline	**Replace pipeline from pond effluent pump station to tertiary facilities area on main treatment site**					
	Length	Diameter	Material			Notes
Pond Effluent Pipeline	1000 ft	34"	Concrete			
Replace Pump Station Structure	**Replace wooden pump structure with new structure serving same function**					
	No of stories	Length	Width	Height	Construction Material	Notes
Pond Effluent Pier	0				Wood pier	Replace pier with identical structure
Replace Pumping Equipment	**Replace pumps and motors**					
	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Pond Effluent Pumps	Vertical	4	0	8	mgd	

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Oxidation Ponds / Recirculation Channel ***Open channel conveyance system to feed and recirdulate contents of ponds***

Improvement	*Description*
New Bar Screens and Debris Removal Tools	**Replace bar screens and install support equipment to ease removal of captured debris**

	Type	Description	Notes
Trash Rake	Atlas Polar Trash Rake	Mechanized rake to collect material off of new bar screens	
Recirc Channel Bar Screen	Bar Screen	~11 ft tall x 50 ft wide	

Replace Control Gates	**Replace pond operation diversion gates at recirculation pump station**

	Type	Description	Notes
Control Gates	Slide Gates	4 steel gates located at the recirculation pump station	

Replace Electric Power Distribution	**Replace conduits, wiring, and switchgear feeding recirculation channel aerators and recirculation pump station**

	Type	Description	Notes
Recirculation Pump Station Power Distribution	Recirculation PS Eletrical	Conduits and wiring	

Replace In-Channel Mechanical Aerators	**New floating aerators in recirculaiton channel between primary effluent discharge and recirculaiton pump station**

	Type	Description	Notes
Recirculation Channel Aeratiors	Mechanical Aerators	6 in-channel aerators, 20 hp each	Replace the 6 aerators that are currently used in the pond recirculation channel upstream of the recirculation pump station

Replace Recirculation Pumps	**Replace pumping equipment and modify inlet, discharge, and maintenance structures to suit**

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Recirculation Pumps	Axial Flow	4	0	64	mgd	

Solids Return Pipeline to Ponds	**Build new solids return piping that will allows for even distribution of solids disposal in the ponds.**

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Oxidation Ponds / Recirculation Channel

Open channel conveyance system to feed and recirdulate contents of ponds

Improvement	*Description*			
	Length	Diameter	Material	Notes
Flexible Solids Piping	150 ft	8"	Flexible piping	
Solids Pipeline	3600	8"	DI	
Floating Solids Piping	6000 ft	8"	PVC pipe on floats	

Ammonia Removal / Nitrifying Fixed Growth Reactors

Existing nitrification process, may need alternative process for new ammonia limits

Improvement	*Description*					
Digester / Dewatering Return Flow Station	**Facility to mix high ammonia return streams with incoming pond effluent**					
	Length	Diameter	Material			Notes
Return Piping	1500 ft	8 inch				
	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Return Pumps	Centrifugal	2	0	200	gpm	On a concrete pad 10 ft x 10 ft
New NTF Influent Pump Station	**New influent pump station for application of incoming pond effluent to tops of NTF tower distributors**					
	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Influent Pumps	Vertical	6	175	16	mgd	29 ft x 94.5 ft footprint
Protective Grid for Media	**Plastic grating applied to top of media for long term protection from maintenance and hydraulic fatigue**					
	Type	Description				Notes
Protective Grid ove NTF Media	Media Protection Grid	6650 sq ft for each NTF				
Rehabilitate Fixed Growth Reactor Tower Structures	**Seismic reliability upgrades and restoration of corroded structural components**					
	No of stories	Length	Width	Height	Construction Material	Notes
Concrete rehab	0				Concrete	6500 sq ft chip and resurfacing allowance - assumed 80% surface area for 3 NTFs
Replace Flow Distributors	**New mechanical rotary distributors that apply pond effluent over top of fixed growth reactor media modules**					

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Ammonia Removal / Nitrifying Fixed Growth Reactors

Existing nitrification process, may need alternative process for new ammonia limits

Improvement	*Description*						
	Type	Description					Notes
Flow Distributors	EIMCO flow distributors	92 ft diameter, 4 arms per distributor, one for each of 3 NTFs					Stainless Steel
Replace Upper Layers of Media	**Replace media layers that have been exposed to sunlight and application of pond effluent**						
	Type	Description					Notes
NTF Media	Trickling filter media	Crossflow media, replace up to 4 ft of depth					Total of 80,000 cf
Restore Ventilation Fans	**Restore fixed growth reactor plenum ventilation fans**						
	Type	Description					Notes
Ventilation Fans	Ventilation Fans	4 per NTF, 5250 cfm each					All fans were removed previously, replace all fans in all NTFs
Snail Control Chemical Feed Station	**New chemical feed station designed to support periodic application of predator control chemicals**						
	Type	Quantity	Horse power	Capacity	Capacity Units		Notes
Caustic/Ammonia Metering Pumps	Chemical Pumps	2	1	36	gpm		
	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Caustic/Ammonia Storage Tanks	2					Fiberglass	6000 gal capacity

Dissolved Air Flotation Clarification / Dissolved Air Flotation Reactors

New rectangular DAFs

Improvement	*Description*						
DAF Tanks	**New rectangular concrete tanks**						
	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
DAF Tanks	4	37 ft	25 ft	10 ft		Concrete	Assume 10 lb/ft^2-day
Float Conveyance Pipe	**New pipe to convey float to anaerobic digesters**						

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Dissolved Air Flotation Clarification / Dissolved Air Flotation Reactors *New rectangular DAFs*

Improvement	*Description*						
	Length	Diameter	Material				Notes
Algae Float Pipe	500 ft	6 in					Float will be between 4%-5% solids
Replace Chemical Feed Pump Equipment							
	Type	Quantity	Horse power	Capacity	Capacity Units		Notes
Polymer Feed Pumps	Chemical Feed Pumps	2	0	10	gal / hr		
	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Polymer Storage Tank	1			5 ft	10 ft		Capacity 1700 gal
Tank Equipment	**New DAF collection equipment**						
	Type	Description					Notes
DAF Equipment	AquaDAF or similar	Chain and flights plus other mechanical equipment for 4 DAFs					

Dual Media Filtration / Filters -

Improvement	*Description*		
Repace Control Valves	**Filter control valves and rate measuring equipment**		
	Type	Description	Notes
Control Valves	Control Valves	Replace valves on all four filters	
Replace Controls	**Automation equipment controlling filter run sequences and filter backwash sequences**		
	Type	Description	Notes
New PLC	PLC	Replace existing controls with a PLC for controlling feed and backwash operation for four filters	

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Dual Media Filtration / Filters -

Improvement	*Description*
Replace Filter Media	**Anthracite and sand media**

	Type	Description	Notes
Anthracite Media	Anthracite Media	3840 cu ft of media per filter	Replace media in all four filters
Sand Media	Sand Media	1440 cu ft of media per filter	Replace media in all four filters

Replace Filter Underdrains	**Replace nozzles and nozzle support structures**

	Type	Description	Notes
Filter underdrains	Valves and nozzles	Replace valves and nozzles for each of four filters	

Replace Mechanical Equipment	**Replace backwash pumps and backwash air blowers**

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Backwash Blowers		4	0	3840	cfm	5 psig
Backwash Pumps		4	0	8400	gpm	20 ft TDH

Disinfection / Contact Reactors -

Improvement	*Description*
Improve Flow Distribution Channel	**-**

	Type	Description	Notes
Rapid Mixer	Rapid Mixer	Mixer used for sodium hypochlorite addition for final effluent disinfection	10 -12 hp

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Channel Modifications	0	10.3 ft	10.3 ft	7 ft		Concrete	Modifications to analysis room to create a vault for mixing with sodium hypochlorite addition. Concrete allowance for this.

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Disinfection / Contact Reactors -

Improvement	*Description*
New Effluent Flow Measurement	-

	Type	Description	Notes
Effluent Flow Meter	In pipe mag meter with vault		Range of flows to be measured is 0-100 mgd

Rehabiltate Concrete Tanks -

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Replace concrete	4	372	10 ft	12 ft		Concrete	Assume an allocation for replacement of concrete over 50% of each unit's surface area for a total of 25,000 square ft

Disinfection / Disinfectant Management -

Improvement	*Description*
New Sodium Hypochlorite Feed Pump Station	-

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Chemical Feed Pumps	Chemical Feed Pumps	2	0	2	gpm	

New Sodium Hypochlorite Storage **Storage tanks and spill containment structure**

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Sodium Hypochlorite Storage	1			30	12	Polyethelene	25,000 gal capacity to store approximately 1 weeks worth of sodium hypo

Anaerobic Digestion / Digesters Improvements *Upgrades to existing anaerobic digestion tanks and feed system*

Improvement	*Description*
Digester cover conversions	**Conversion of floating covers to fixed covers**

	Type	Description	Notes
Cover Conversion	Digester Fixed Cover	Replacement of floating covers on three digesters	Continuation of cover conversions already in process

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Anaerobic Digestion / Digesters Improvements ***Upgrades to existing anaerobic digestion tanks and feed system***

Improvement	*Description*
Digester mixing equipment upgrades	**Convert from gas mixing to pumped mixing systems**

	Type	Description	Notes
Mixing Upgrades	Digester Mixing Upgrades	Mixing upgrades on the remaining digesters	Continuation of work already in progress

Pumping and piping system upgrades — **Upgrades to improve automated continuous feed, mixing, and withdrawal from digesters and to support Class A process configuration**

	Type	Description	Notes
Stand Pipe	Stand pipe for digester withdrawl	Typical BC design, digesters have side water depth of 33 ft	Needed in all 4 digesters

	Length	Diameter	Material	Notes
Withdrawal piping	~450 ft	4 in	Steel	Piping allocation for withdrawal system
Feed loop piping	350 ft	4 in	Glass lined steel	Piping in feed loop system that allows for continuous feed to the digesters

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Loop feed pump	Positive displacement rotary lobe	2		100	gpm	Pumps will operate at 100 gpm to maintain velocities in feed loop piping
Digester 4 Feed Pumps	Positive displacement rotary lobe pump	1		45	gpm	Feed pump for Digester 4
Digesters 1-3 Feed Pump	Positive displacement rotary lobe pump	3		30	gpm	Pumps for digesters 1 - 3

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Solids Dewatering / Solids Dewatering Structures and Equipment -

Improvement	*Description*
New Solids Dewatering Building	**New building to support mechanical solids dewatering system**

	No of stories	Length	Width	Height	Construction Material	Notes
Solids Dewatering Building	0					

New storage and truck loadout facility — **Dewatered solids cake storage hoppers with truck loadout facilities to accommodate direct removal of dewatered solids to re-use sites**

	Type	Description	Notes
Sludge Hoppers	Sludge Hoppers	2 units at 6,000 ft3 each	Include hopper loading conveyors, 2 per unit

Polymer Mixing and Feed System -

	Type	Description	Notes
Polymer Feed and Storage	Pumps, blending units and storage tanks		

Solids Dewatering Machines -

	Type	Description	Notes
Inclined Collection Conveyors	Inclined Collection Conveyors	2 units at 30,000 lbs/hr	
Hopper Distribution Conveyors	Hopper Distribution Conveyors	2 units at 30,000 lbs/hr	
Centrifuge Classifying Conveyor	Classifying Conveyor	2 units at 12,000 lbs/hr each	
Centrifuge	Centrifuge	2 units at 1800 - 2000 lbs/hr each	Design criteria - 300 gpm/unit
Horizontal Collection Conveyors	Horizontal Collection Conveyors	2 units at 30,000 lbs/hr	

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Recycled Water / Recycled Water Production — *4-mgd facility dedicated only to recycled water*

Improvement	*Description*
New DAF, Dual Media Filters and Chlorine Tanks	**Equipment to treat secondary treatment effluent for discharge into the recycled water distribution system**

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Dual Media Filters	4	22 ft	22 ft	66 in		Concrete	Hydraulic loading - 5.0 gpm/sq ft
DAF Tanks	4	15 ft	10 ft	10 ft		Concrete	Assume 10 lb/ft^2-day
Chlorine Contact Tanks	2	372 ft	10 ft	12 ft		Concrete	90 min det time per Title 22

Landfill Gas Management / Landfill Gas Booster and Flare System -

Improvement	*Description*
Demolish Old Booster and Flare Station	**Demo of remaining equipment to bring site to construction ready condition**
Relocate Booster and Flare Station	**Upgrade aged equipment and relocate to resolve conflict with planned ugrade for headworks facilities**

Electric Power / Electrical Power Distribution — *Main Distribution Center, includes stand-by power*

Improvement	*Description*
Diesel Fuel Tank	**For stand-by power**

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Diesel Fuel Tank	1			6 ft	5 ft	HDPE	5,000-gallon tank, includes piping and control panel

Power Distribution Center Building — **Houses main switchgears and stand-by power**

	No of stories	Length	Width	Height	Construction Material	Notes
Power Dist Center Building	1	50	15	15	CMU	

Stand-By Power (Engine Generator) — **Located within Power Distribution Center building; operates off diesel fuel**

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Electric Power / Electrical Power Distribution — *Main Distribution Center, includes stand-by power*

Improvement	*Description*					
	Type	Description				Notes
Standy-By-Power	Stand-By Power	Diesel Fueled Stand-by Generators				2,000-kW capacity total
Switchgear 1	**New switching, conductors, conduits and transformers to provide redundant feed system**					
	Type	Description				Notes
Switchgear 1	12 kV Switchgear	8-ft x 15-ft x 6-ft height				All breakers rated 600 A @ 12.47 kV (15 kV), 500 MVA Interrupt (23 KA)
Switchgear 2	**New switching, conductors, conduits and transformers to provide redundant feed system**					
	Type	Description				Notes
Switchgear 2	12 kV Switchgear	8-ft x 18-ft x 6-ft height				All breakers rated 600 A @ 12.47 kV (15 kV), 500 MVA Interrupt (23 KA)

Electric Power / Biogas Power Generation — *Optimization of existing biogas power generation system*

Improvement	*Description*					
Replace engines with ARES technology						
	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Cogen Unit	Engine-Driven Cogen Unit	3	225	1200	RPM	Assume Waukesha

Electric Power / Headworks/Primaries Substation — *Main switchgears transfer power to area substation*

Improvement	*Description*					
Headworks and Primaries Substation	**Transfers power to influent pumping station, headworks, and primaries (receives 12.47 kV)**					
	No of stories	Length	Width	Height	Construction Material	Notes
HW/Prim Area Substation	1	10 ft	7 ft	12 ft	Concrete	Capacity = 480 V

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Electric Power / Tertiary Area Substation — *Main switchgears transfer power to area substation*

Improvement	*Description*
Tertiary Area Substation	**Transfers power to filters or UV disinfection facilities (receives 12.47 kV)**

	Type	Description	Notes
Tertiary Area Substation	12 ft	10 ft	7 ft

Digester Gas Management / Gas Storage — *Gas storage for equalization within cogen system*

Improvement	*Description*
Gas Storage Tank	

	Quantity	Length	tank_width	Depth	Diameter	Construction Material	Notes
Gas Storage Tank	2			45 ft	45 ft	Stainless Steel	50,000 gal each

Digester Gas Management / Gas Moisture Reduction — *Removal of water from digester gas*

Improvement	*Description*
Gas Moisture Reduction	

	Type	Description	Notes
Gas Chiller	Digester Gas Chiller	2 units	
Heat Exchager	Gas Conditioning HEX	1 unit	
Moisture Separator	Equipment	1 unit	Gas moisture separator

Digester Gas Management / Gas Purification — *Removes slioxane and H2S from digester gas*

Improvement	*Description*
H2S removal	

	Type	Description	Notes
Iron Sponge Unit	Iron Oxide Vessel	4 units	4 ft diameter and 4 ft of bed depth Iron Sponge or SulfaTreat

Siloxane removal

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Digester Gas Management / Gas Purification — *Removes slioxane and H2S from digester gas*

Improvement — *Description*

	Type	Description	Notes
Activated Carbon Filter	Activated Carbon Filter	2 units	4 ft diameter and 4 ft bed depth

Digester Gas Management / Gas Compressors — *Boost pressure of digester gas for cogen engines*

Improvement — *Description*

Gas Booster Blowers

	Type	Quantity	Horse power	Capacity	Capacity Units	Notes
Gas Booster Blowers	Centrifugal	2		225	cfm	4 psig assumed pressure

Digester Gas Management / Boilers — *Back up heat source*

Improvement — *Description*

Boiler

	Type	Description	Notes
Boiler	Gas/Oil Boiler		Gas/oil combination, gross output 9,800 MBH, 286 BHP Includes burners, controls, insulated jacket

Digester Gas Management / Flares — *Excess digester gas wasting*

Improvement — *Description*

Flares

	Type	Description	Notes
Flare	Waste gas flares	Two units	6" flares and associated equipment

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Community / Environment Enhancements / Civil/Site Work Existing Plant Area ***Roadwork and final grading around plant site***

Improvement	*Description*
Civil/Site Work within the existing plant area	**Roadwork, final grading, storm drainage and yard piping around plant site**
New Administration Building	**New building will contain offices, meeting rooms and laboratory facilities**
New Maintenance Building	**New building that will serve all maintenace and garage functions**

Community / Environment Enhancements / On-Site Features ***Improvement to enhance site***

Improvement	*Description*
New Route	**Alternative access route for site service**

Community / Environment Enhancements / Off-Site Features ***Improvements to bay trail area***

Improvement	*Description*
Parking Improvements	**Additional parking at head of bay trail**
Trail Improvements	**Education kiosks and oxidation pond trail features**

Demolition of Existing Facilities / Demo Auxiliary Pump Station ***Demolish auxiliary pump station***

Improvement	*Description*
Demolish existing pump station	**Abandon / demolish existing structure**

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Demolition of Existing Facilities / Demo 66-inch Pipe ***Demo existing pipe***

Improvement	*Description*
Demolish Existing 66-inch pipe	**Pipeline on south and west sides of primary sedimentation tanks**

Demolition of Existing Facilities / Demo 24-inch and 30-inch Pipes ***Demo existing pipes***

Improvement	*Description*
Demolish existing 24-inch and 30-inch pipes	**Remove three 24-inch and two 30-inch pipelines from Control Building and Auxillary PS to the Primary Clarifiers**

Demolition of Existing Facilities / Demo Primary Sedimentation Tanks 1 - 5 ***Demo existing tanks and equipment***

Improvement	*Description*
Demolish Existing Primary Sedimentation Tanks 1-5	**Demolish tanks, associated equipment and underground galleries**

Demolition of Existing Facilities / Demo Primary Sedimentation Tanks 6 - 10 ***Demo existing tanks and equipment***

Improvement	*Description*
Demolish Existing Primary Sedimentation Tanks 6-10	**Demolish tanks, associated equipment and underground galleries**

Demolition of Existing Facilities / Demo Primary Control Building ***Demolish existing headworks and existing primary control building***

Improvement	*Description*
Demolish Primary Control Building	**Function of this structure will be replaced with new facilities**

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Demolition of Existing Facilities / Demo Sludge Dewatering Bins ***Demo existing structure***

Improvement	*Description*
Demolish Existing Sludge Dewatering Area	**Restore sludge berm. Digested sludge routed to oxidation ponds for extended stabilization**

Demolition of Existing Facilities / Demo Chlorination Building ***Demo building and equipment***

Improvement	*Description*
Demolish Chlorination Building	**With switch to sodium hypochlorite this structure is no longer needed**

Demolition of Existing Facilities / Demo Dechlorination Building ***Demo building and equipment***

Improvement	*Description*
Demolish Dechlorination Building	**With switch to sodium hypochlorite this structure is no longer needed**

Demolition of Existing Facilities / Demo Chemical Storage Area ***Demo equipment, including chlorine scrubbers***

Improvement	*Description*
Demolish Chemical Storage Area	**With switch to sodium hypochlorite this structure is no longer needed**

Demolition of Existing Facilities / Demo DAFT Area ***Demo all tanks and equipment***

Improvement	*Description*
Demolish Existing DAFT Area	**Circular DAF tanks and all structures and equipment associated with the tanks will be demolished**

Recommended Improvemens for Key Plant Process Rehabilitation Scenarios

Demolition of Existing Facilities / Demo Float Pumping Station ***Demo building and equipment***

Improvement	*Description*
Demolish Float Pumping Station	**Function replaced by new struction, demo of structure and equipment**

Demolition of Existing Facilities / Demo Fixed Growth Reactor Pump Station ***Demo building and equipment***

Improvement	*Description*
Demolish FGR Influent Pump Station	**Function replaced by new struction, demo of structure and equipment**

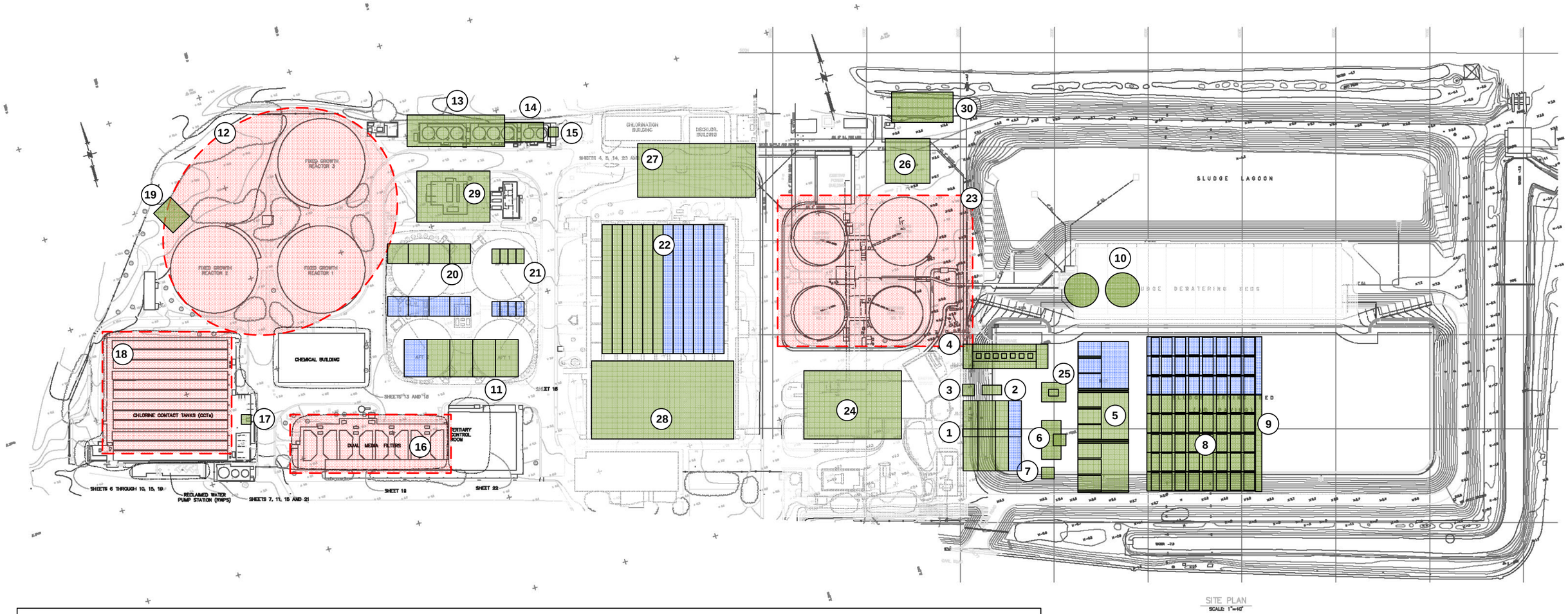
Demolition of Existing Facilities / Demo Administration Building ***Abandon/demolish existing structure***

Improvement	*Description*
Demolish Existing Adminstration Building	**Function to be replaced by new structure**

Demolition of Existing Facilities / Demo Maintenance Building and Garage ***Demo existing maintenance shed and move equipment to new facility***

Improvement	*Description*
Demolish Existing Maintenance Building	**Function to be replaced by new structure**

ATTACHMENT B: SITE LAYOUTS



SITE PLAN
SCALE: 1"=40'

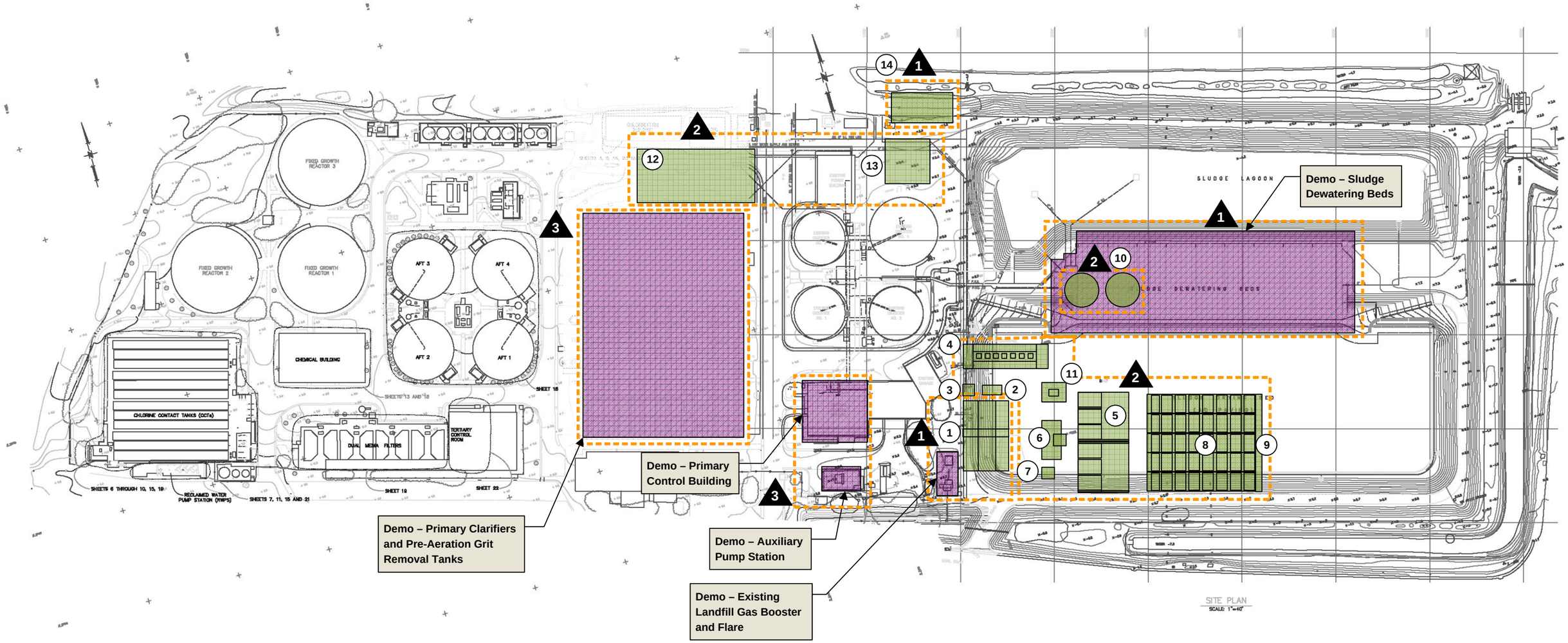
KEY

1. Screening Facility
2. Screenings Washer / Compactors
3. Screenings Storage Bin Station
4. Raw Sewage Pump Station
5. Grit Removal Tanks and Equipment Gallery
6. Grit Washer / Compactors
7. Grit Storage Bin Station
8. Primary Sedimentation Tanks
9. Primary Effluent Channel
10. Primary Sludge Thickeners
11. Rectanglar DAFTs
12. Upgrades and Rehabilitation: Nitrifying Trickling Filters
13. NTF Influent Pump Station
14. Snail Control Chemical Feed Station
15. Digester / Dewatering Return Flow Pump Station
16. Dual Media Filter Improvements
17. New Vault with Rapid Mixer
18. Chlorine Contact Tank Improvements
19. New Sodium Hypochorite Storage Tank
20. Rectangular DAFTs (Recycled Water)
21. Dual Media Filtration (Recycled Water)
22. Chlorine Contact Tanks (Recycled Water)
23. Anaerobic Digester Improvements
24. Solids Dewatering Building
25. Headworks and Primaries Area Substation
26. Relocated Site Utilities from Primary Control Building (Hot Water, Plant Air, etc.)
27. Power Distribution Center (with Stand-By Power)
28. New Administration Building
29. New Maintenance Facility
30. New Location of Landfill Gas Booster Blowers and Landfill Gas Flare

LEGEND

- New Construction
- Future Construction
- Improvements to Process

SITE	Sunnyvale Strategic Implementation Plan Existing Plant Rehabilitation Alternative		
TITLE	Final Layout (Including Ultimate Influent Flow Allocation)		
BROWN AND CALDWELL	DATE October 2009	PROJECT 135083-005-001	Figure B-1

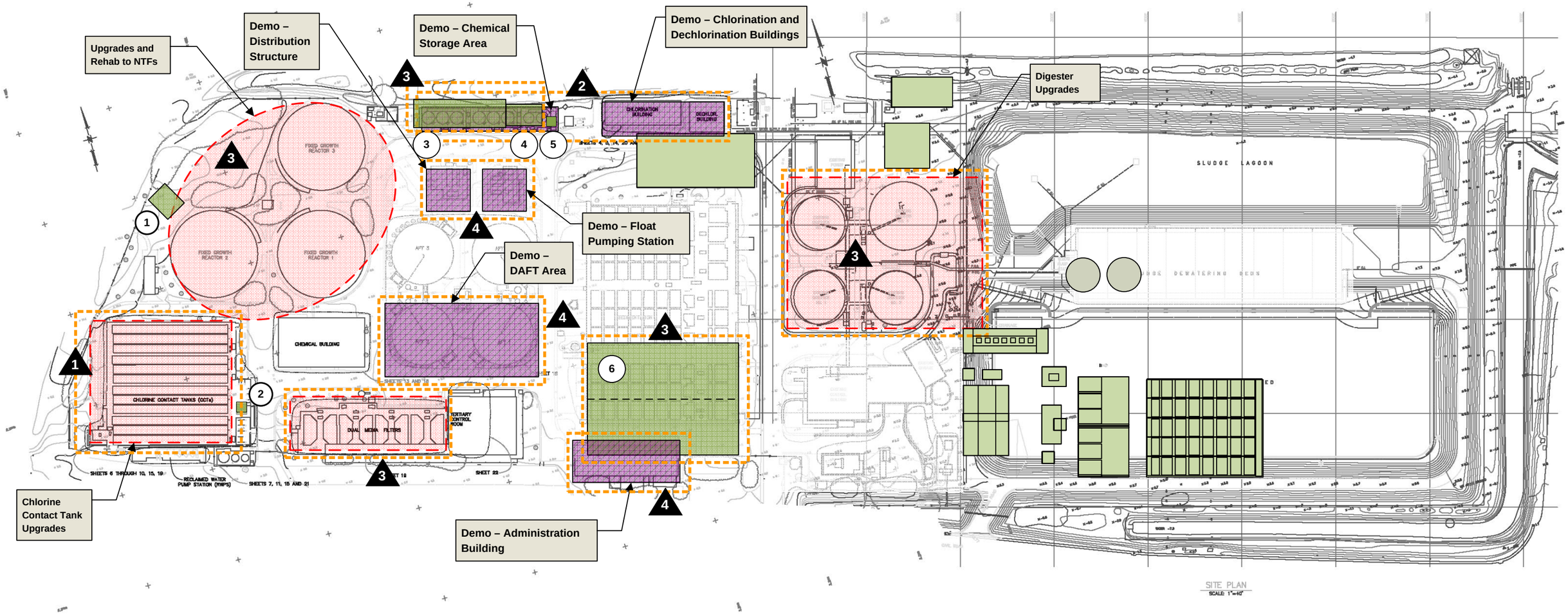


LEGEND	STAGES
Demolition	1
New Construction	

KEY

1. Screening Facility
2. Screenings Washer/Compactors
3. Screenings Storage Bin Station
4. Raw Sewage Pump Station
5. Grit Removal Tanks and Equipment Gallery
6. Grit Washer/Compactors
7. Grit Storage Bin Station
8. Primary Sedimentation Tanks
9. Primary Effluent Channel
10. Primary Sludge Thickeners
11. Headworks and Primaries Area Substation
12. Power Distribution Center (with Stand-By Power)
13. Relocated Site Utilities from Primary Control Building (Hot Water, Plant Air, etc.)
14. New Location of Landfill Gas Booster Blowers and Landfill Gas Flare

SITE: Sunnyvale Strategic Implementation Plan Existing Plant Rehabilitation Alternative		
TITLE: Early Execution Projects		
BROWN AND CALDWELL	DATE: October 2009	Figure B-2
	PROJECT: 135083-005-001	



KEY

1. Sodium Hypochlorite Storage Tank
2. Vault with Rapid Mixer
3. NTF Influent Pump Station
4. Snail Control
5. Digester / Dewatering Return Pump Station
6. New Administration Building (To be built in two phases)

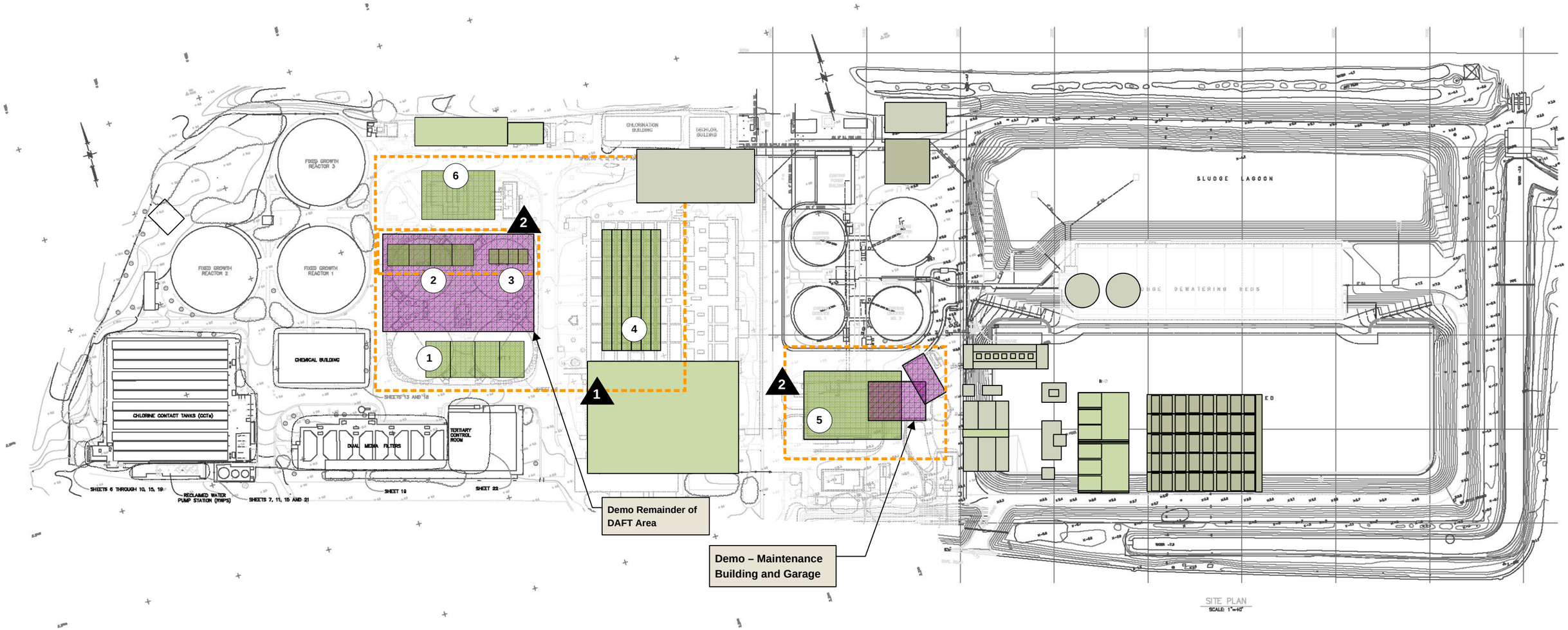
LEGEND

- Demolition
- New Construction
- Improvements to Process

STAGES

1

SITE	Sunnyvale Strategic Implementation Plan Existing Plant Rehabilitation Alternative
TITLE	Ponds, Tertiary System and Solids
BROWN AND CALDWELL	DATE: October 2009 PROJECT: 135083-005-001
	Figure B-3



LEGEND	STAGES
New Construction	1
Demolition	

KEY

1. Rectangular DAFTS
2. DAFTS (Recycled Water)
3. Filters (Recycled Water)
4. Chlorine Contact Tanks (Recycled Water)
5. Solids Dewatering Building
6. Maintenance Facility

SITE: Sunnyvale Strategic Implementation Plan Existing Plant Rehabilitation Alternative		
TITLE: Dewatering and Recycled Water		
BROWN AND CALDWELL	DATE: October 2009 PROJECT: 135083-005-001	Figure B-4

ATTACHMENT C: CONSTRUCTION COST SUMMARY TABLE

Summary of Project Costs for Plant Rehabilitation Alternative

Process Location Number	Revised Name	Plant Rehabilitation Alternative		
		Bid Pkg 1	Bid Pkg 2	Bid Pkg 3
		2/15/11 - 2/15/14	2/15/14 - 8/15/16	8/15/16 - 8/15/18
1100	Civil/Site Work Existing Plant Area			3,339,429
1101	Raw Sewage Pumping Station	5,907,094		
1102	Screening	3,647,864		
1103	Grit Removal	4,326,682		
1105	Landfill Gas Booster and Flare System	841,997		
1106	Primary Sedimentation Tanks	15,427,553		
1107	New Administration Building		3,099,792	
1108	Area Substation - Headworks/Primaries	4,005,114		
1109	Demolition - Auxilliary Pump Station	3,371,016		
1110	Demo - Sludge Dewatering Bins	3,935,218		
1111	Demo - Primary Sedimentation Tanks 1-5	1,406,182		
1112	Demo - Primary Sedimentation Tanks 6-10	1,230,905		
1113	Primary Effluent Pipeline	2,617,825		
1114	Demo - 66" RCP	47,521		
1115	Demo - 24" and 30" Pipe	143,954		
1116	Demo - Primary control Building	1,736,361		
1117	Relocated Utilities Building	1,522,102		
1118	Area Substation - Tertiary		3,093,133	
1119	Sludge Lagoon			15,690,963
1120	Community Improvements - On-Site Features			228,081
1121	Community Improvements - Off-Site Features			83,334
1129	Maintenance Building			1,096,140
1130	Demo - DAFT Area		1,360,698	
1131	Demo - Chlorination Building		502,175	
1132	Demo - Dechlorination Building		180,594	
1133	Demo - Chemical Storage Area		532,448	
1134	Demo - Float Pumping Station		883,274	
1135	Demo - FGR Pump Station		1,032,767	
1136	Demo - Existing Administration Building		275,361	
1137	Demo - Maintenance Building and Garage			324,816
2101	Primary Sludge Thickening	1,878,872		
2102	Oxidation Ponds		7,012,608	
2103	Pond Effluent Pump Station		3,402,035	
2104	Oxidation Ponds Recirculation Channel		4,939,621	
2105	Nitrifying Fixed Growth Reactors		8,317,559	
2106	Dissolved Air Flotation Clarification			12,462,647
2109	Dual Media Filtration		3,297,424	
2110	Chlorine Contact Reactors		916,412	
2111	Disinfectant Management		2,653,685	
2116	Solids Dewatering			24,259,680
2117	Recycled Water System (Filters, Cl2)			15,013,080
2118	Main Power Distribution Center	2,713,084		
2119	Biogas Power Generation			10,275,886
3104	Anaerobic Digesters		17,323,203	
3107	Gas Storage		3,514,789	
3108	Gas Moisture Reduction		1,041,350	
3109	Gas Purification		816,736	
3110	Gas Compressors		347,976	
3111	Boilers		469,850	
3112	Digester Gas Flares		2,060,618	
Subtotal		54,759,344	67,074,108	82,774,056
Total		**204,607,508**		

ATTACHMENT D: OPERATIONAL COST SUMMARY TABLE

Estimated Quantities of Plant Consumables

	Task 4			
	Electrical (kW-hr/yr)	Chemicals (gal/yr)	Labor (qualitative)	Hauling (wet ton/yr)
Preliminary Treatment				
Raw Sewage Pumping	743,684			
Grit Removal				
Grit Pumping	261,293			
Aeration Blowers	391,340			
Primary Treatment				
Primary Sedimentation Tanks				
Sludge Pumping	9,944			
Scum Pumping	45,072			
Secondary Treatment				
Oxidation Ponds				
Recirculation Pumping	174,497			
Channel Aerators	124,425			
Effluent Pumping	613,831			
Dredge Pumping	30,862			
Dredging Booster Pumping	10,287			
Tertiary Treatment				
Nitrifying Fixed Growth Reactors				
Feed Pumping	1,080,000			
Ventilation Fans	435,490			
Ammonium Sulfate		5,000		
Caustic Soda		2,000		
Dual Media Filtration				
Backwash Pumping	146,577			
Backwash Blowers	432,032			
Sodium Hypochlorite Disinfection				
Booster Pumping	391,636			
Mixer	87,100			
Sodium Hypochlorite		34,353		
Sodium Bisulfite		40,122		
Solids Handling				
Dissolved Air Flotation Clarification				
Pressurization Pumping	817,083			
Unit Power	98,050			
Air Compressor	39,755			
Thickened Sludge Pumping	4,367			
Polymer		81,814		
Anaerobic Digestion				
Feed Pumping	10,218			
Circulation Pumping	94,400			
Digester Mixing Pumping	888,602			
Digested Sludge Transfer Pumping	9,692			
Centrifuges				
Centrifuge Power	246,199			
Polymer		6,370		
Biosolids Hauling				8,600
Recycled Water				
Recycled Water System (DAFT, Filters, Cl2)				
Pressurization Pumping	102,135			
Unit Power	98,050			
Air Compressor	4,969			
Thickened Sludge Pumping	546			
Polymer		21,915		
Backwash Pumping	63,342			
Backwash Blowers	259,219			
Sodium Hypochlorite		9,460		